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INFLUENCE OF ARCTIC CLOUD THERMODYNAMIC PHASE ON SURFACE SHORTWAVE FLUX

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ABSTRACT

As part of the Indirect and Semi-Direct Aerosol Campaign (ISDAC) an Analytical Spectral Devices (ASD, Inc.) spectroradiometer was deployed at the Barrow NSA site during April and May of 2008, and in April-October of 2009. This instrument recorded one-minute averages of surface downwelling spectral flux in the wavelength interval 350-2200 nm, thus sampling the two major near infrared windows (1.6 and 2.2 microns) in which the flux is influenced by cloud microphysical properties including thermodynamic phase and effective particle size. Aircraft in situ measurements of cloud properties show mostly mixed-phase clouds over Barrow during the campaign, but with wide variability in relative liquid versus ice water content. At fixed total optical depth, this variability in phase composition can yield of order 5-10 Watts per square meter in surface flux variability, with greater cloud attenuation of the surface flux usually occurring under higher ice water content. Thus our data show that changes in cloud phase properties, even within the "mixed-phase" category, can affect the surface energy balance at the same order of magnitude as greenhouse gas increases. Analysis of this spectral radiometric data provides suggestions for testing new mixed-phase parameterizations in climate models.